Cordierite
$\text{A}_2\text{Al}_4\text{Si}_5\text{O}_{18}$
$\text{A} = \text{Mg, Fe, Mn, Co, Cu, K}$

Presented by
Joyleen Desai

Occurrences
- Product of metamorphism in aluminous rocks
- Less commonly found in igneous rocks

Physical Properties
- Color: pale blue, colorless, violet
- Luster: vitreous
- Hardness = 7-7.5
- Specific Gravity = 2.5-2.8
- Cleavage: good (010), poor (100)
Optical Properties

- Clear to pale blue
- Pleochroic
- Tiny yellow pinnite crystals are the result of alteration
- Uniaxial (+ or -)

Structure

Structural Cell Parameters

- Space group: Cccm
- Point group: 2/m2/m2/m
- Density: 2.56 g/cm³

\[
\begin{align*}
a &= 1.536 \\
\beta &= 1.540 \\
\gamma &= 1.543 \\
2V_\alpha &= 80°
\end{align*}
\]

\[
\begin{align*}
a &= 17.079 \\
b &= 9.730 \\
c &= 9.356 \\
d &= 0.02
\end{align*}
\]

Reference: Cohen et al. (1977)
Indialite Structure

• High-temperature modification of cordierite
• Space group $P6/mcc$
• Hexagonal symmetry
• Has a disordered Al,Si configuration
• Isostructural with beryl

Hydrous Cordierite

• Corner-sharing tetrahedra leaves open channels parallel to (001) that may contain $H_2O$
  – Less commonly may contain $CO_2$, $K^+$, or $Na^+$

Thermal Expansion

<table>
<thead>
<tr>
<th>$T$ ($^\circ$C)</th>
<th>$a$</th>
<th>$b$</th>
<th>$c$</th>
<th>$V$</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>17.064</td>
<td>9.721</td>
<td>9.340</td>
<td>1549.4</td>
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<tr>
<td>100</td>
<td>17.067</td>
<td>9.721</td>
<td>9.335</td>
<td>1548.8</td>
</tr>
<tr>
<td>200</td>
<td>17.069</td>
<td>9.717</td>
<td>9.333</td>
<td>1548.0</td>
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<tr>
<td>Discontinuity</td>
<td>250</td>
<td>17.071</td>
<td>9.720</td>
<td>9.330</td>
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<tr>
<td>300</td>
<td>17.087</td>
<td>9.724</td>
<td>9.330</td>
<td>1550.3</td>
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<tr>
<td>400</td>
<td>17.090</td>
<td>9.728</td>
<td>9.330</td>
<td>1551.2</td>
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<tr>
<td>Discontinuity</td>
<td>600</td>
<td>17.100</td>
<td>9.731</td>
<td>9.335</td>
</tr>
<tr>
<td>800</td>
<td>17.113</td>
<td>9.737</td>
<td>9.329</td>
<td>1554.5</td>
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<tr>
<td>950</td>
<td>17.128</td>
<td>9.744</td>
<td>9.333</td>
<td>1557.8</td>
</tr>
</tbody>
</table>

Reference: Mirwald (1981)
Thermal Expansion

- No indication of crystal symmetry change
- Negative thermal expansion below V minimum at 275°C
- Clapeyron slope ($\frac{dP}{dT} = \frac{\Delta V}{\Delta T} k$) is (+) at 275°C discontinuity, and may be (–) at 600°C discontinuity

Compression

Reference: Koepke and Schultz (1986)

Compression

- Koepke and Schultz (1986) did not observe discontinuities at 0.2 and 0.9 GPa that Mirwald et al. (1984) did
- Koepke and Schultz concluded that there were no phase changes associated with increasing pressures up to 2.3 GPa
Uses of Cordierite

- Thermal shock-resistant refractory bricks
- Ceramics